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Chronological variation in landing of Indian Major Carp (IMC) of Ganga River

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Abstract

During its course of 2,525 km, the River Ganga flows through the variant topography, ecological, and environmental conditions that harbor huge range of floral, faunal, and fish diversity. The ecological condition and biodiversity of upper, middle, and lower stretches of the river are different from each other. Increases in anthropogenic activities on Ganga have resulted in a decrease in quality and quantity of its water, which ultimately led to change in its biodiversity. Menon (1974) listed 141 fish species occurring in the Ganga River system belonging to 72 genera, 30 families, and 11 orders. Recent studies reported 143 fish species from the River Ganga (Das et al., 2014; Sarkar et al., 2011) including cold water, freshwater, and estuarine fishes. In this article, a critical comparison is made on the availability of an important fish group, the Indian Major Carp (IMC), of the Ganga River during different decades, starting from 1956 and annual yield between 2005 and 2018. Average annual IMC landing during 1955–1967 was recorded as 90.85 ton, with maximum (131.3 ton) during 1964–1965 and minimum (54.0 ton) in the year 1958–1959. There was generally an increasing trend of IMC landing during 2005–2018, but it has reduced to one-third in comparison to the time period of 1956–1967. The analysis shows that catch as well as species composition of IMC had been changed over the period of

time due to changes in hydrological regime and ecology of the river. The reason in totality of this change is a focused theme of this paper.

KEYWORDS
exotic, fisheries, Ganga, IMC, Landing

1 | INTRODUCTION

The River Ganga is a national river of India and an important source of livelihood for the people inhabiting on its bank. During its course of 2,525 km, it flows through the variant topography, ecological, and environmental conditions and harbor huge range of floral and faunal biodiversity. It originates from Gaumukh of Gangotri glacier in Himalaya as Bhagirathi River at an altitude of 3,892 msl and after confluence with Alkananda River at Devprayag known as the Ganga River. Then, it passes through five most densely populated states of India viz. Uttrakhand, U.P. Bihar, Jharkhand, and West Bengal and finally merges to Bay of Bengal at Gangasagar (Vass, Mondal, Samanta, Suresh, & Katiha, 2010). Before debouches in the plan of north India at Haridwar, its upper course is totally hilly in nature and its lower stretch is different from the plan stretch. Therefore, ecological condition and biodiversity of upper, middle, and lower stretches of the river are different from each other. It provides water for bathing, drinking, irrigation, transportation, power generation, and holy purposes to Indians. This led to a dependency of people on Ganga for the livelihood. There are several cities and towns through which river passes on its way to downstream. Several industries and factories are situated in its catchment. To fulfil these demands, several dams and barrages have been constructed across the river. All these have created obstruction and abstraction of Ganga water. Increase in these anthropogenic activities on Ganga resulted in decrease in quality and quantity of its water which ultimately led to change in its floral and faunal diversity. In the Himalayan stretch, its course has been drastically changed due to construction of Tehri dam at Tehri and Bhimgoda barrage at Haridwar (Chauhan, 2007) in the upper stretch and formation of Farakka barrage has resulted in change of biodiversity in lower stretch (Mukherjee & Suresh, 2007). Similar effect has been observed in the middle stretch of the Ganga River due to the formation of different barrages viz. at Bijnor, Narora, and Kanpur. At Allahabad, the River Ganga joins the River Yamuna, a more voluminous river than Ganga. Thereafter, this stretch of the river plays an important role in fish and fishery of the Ganga.

Due to large catchment area and vast habitat variability extending from cold water, warm water, and estuarine zones, the Ganga River supports copious fish diversity (Sinha & Khan, 2001; Talwar & Jhingran, 1991). Menon (1974) listed 141 fish species occurring in the Ganga River system belonging to 72 genera, 30 families, and 11 orders. Recent studies reported 143 fish species from the River Ganga (Das et al., 2014; Sarkar et al., 2011) including cold water, freshwater, and estuarine fishes. Riverine ecosystem of India has suffered from intense human intervention resulting in habitat loss and degradation and as a consequence many fresh water fish species have become endangered, particularly in Ganges basin where heavy demand is placed on fresh water. Chauhan (2007) had observed change in fish and fishery of the river due to the formation of Tehri dam and indicated the disappearance of important cold water fish owing to obstruction in migration of fishes. Mukherjee and Suresh (2007) had studied the impact of Farakka barrage on the fish and fishery of Hilsa and showed a great decline in total catch of Hilsa in the middle and lower stretch of the river. This was coupled with irreversible changes in natural population by introduction of exotic species and diseases (Sarkar, et al., 2011).

Since Ganga River is the natural abode of Major Carp (IMC) and other fishes, the Ganga and its tributaries yield enormous quantities of fish seed (Jhingran & Ghosh, 1978). Therefore, decline in landing of fishes of Ganga is a serious concern. In this article, a critical comparison has been made on the availability of important fishes of the Ganga River during different decades starting from 1956 and annual yield between 2006 and 2018.

2 | MATERIALS AND METHODS

Primary as well as secondary data of fish landings were collected for the period 1955–1956 to 2018 from different sources. Annual average fish landing data for the period 1956–1967 and 1972–2005 were collected as secondary fish landing data (Jhingran & Ghosh, 1978; Jhingran, 1991; Ray, 1998, CIFRI, 1964, and Vass, Tyagi, Pathak, Singh, & Seth, 2008). While catch data for the period 2006–2018 were collected from Sadiayapur and Daraganj fish markets of Allahabad. Stratified random sampling techniques had been used to estimate average monthly fish landing from these fish markets (Tyagi & Mandal, 2008). For collection of data, month had been divided into weeks as different stratum and the data were collected on randomly selected 2 days of a week. Species-wise data were collected from the market. Accordingly, species wise and total catch for monthly and annual had been estimated. Table 1 shows the list of species combined into different groups for recording the landing. For the analysis of collected data and presentation of result, MS-Excel had been used.

TABLE 1 List of species combined into different groups

Species	Common name	Group
Cirrhinus mrigala (Ham.)	Mrigal	Indian Major Carp (IMC)
Catla catla (Ham.)	Catla	
Labeo rohita (Ham.)	Rohu	
Labeo calbasu (Ham.)	Calbasu	
Mystus aor (Ham.)	Tengra	Cat fishes (CF)
Mystus seenghala (Sykes)	Tengra	
Wallago attu (Schneider)	Padhin	
Hilsa ilisha (Ham.)	Hilsa	Hilsa
Cyprinus carpio	Common Carp	Exotics
Oreochromis niloticus	Tilapia	
Remaining Sps.		Others

3 | RESULTS AND DISCUSSION

The upper stretch of the Ganga system in the high altitudes of the Himalayas is declared as no fishing zone. Therefore, no commercial catch data are available for this region. Commercial fish catch in the Ganga River starts from Anupshahar a town in Bulandshahar district of U.P. Therefore, fish catch has been recorded for a total of 1,580 km stretch of the Ganga from Anupshahar in the upper stretch to Lalgola in the eastern lower stretch. Market arrivals of fishes at Kanpur and Allahabad have been grouped in upper stretch and that at Varanasi, Buxar, and Ballia as middle stretch while at Patna, Bhagalpur in the lower stretch of Ganga.

The fluctuations in the annual landings of IMC and total landing of Ganga are shown in Figure 1, while Figure 2 represents the average group-wise landings in the various stretches of the Ganga River during 1958–1968. The fishery of the upper stretches was dominated by all species or only IMC, which contributed, on the average, 38.5% at Allahabad and 5.4% at Kanpur to the annual landings. Middle stretch landings, were dominated by "others" and Hilsa. IMC populations were very low. The lower stretch fishery had a higher abundance of IMC, contributing 20.8% at Patna and 18.3% at Bhagalpur. The "other" fishes were, however, dominant in the lower stretches too. The abundance varied heavily between years and also between centres within years.

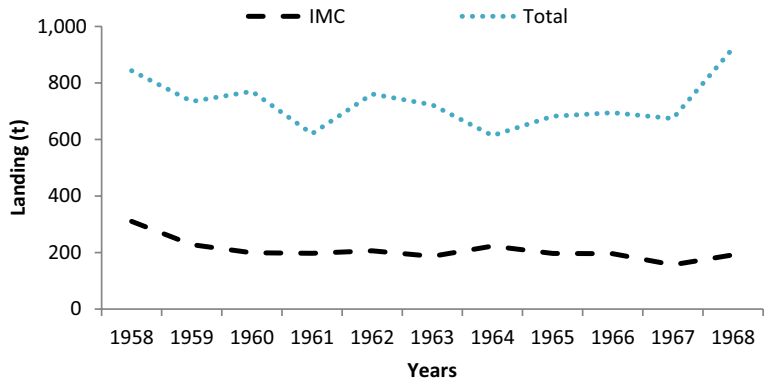

FIGURE 1 Total and IMC landing from Ganga River (1958–1968) (Source: Jhingran & Ghosh, 1978)

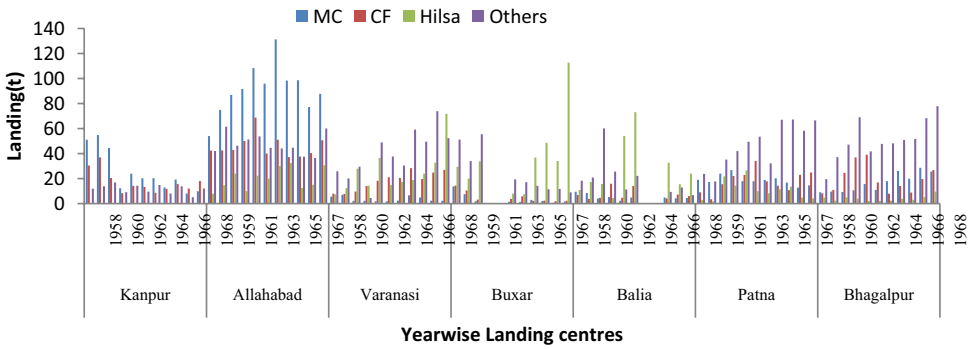

FIGURE 2 Group-wise and center-wise landing from Ganga River (1958–1968) (Source: Jhingran, 1991)

Catch of Indian major carp (IMC) from Ganga River system at Allahabad shows variations since 1955–2018 in Figure 3. The trend was initially on decreasing pattern and then increasing during 1956–1967. Average annual IMC landing during 1955–1967 was recorded as 90.85 ton with maximum (131.3 ton) during 1964–1965 and minimum (54.0 ton) in the year 1958–1959. Although there was an increasing trend of IMC during 2005–2018 but landing of IMC had reduced to one-third in comparison to the time period of 1956–1967. The reason for depletion could be attributed to construction of dam and barrages on Rivers Ganga and Yamuna and its tributaries in the upstream, which ultimately led to reduction in volume of water into the Yamuna and Ganga Rivers at Allahabad. This also created obstacles for migration of fishes in the river (Gupta & Tyagi, 1992; Vass et al., 2008).

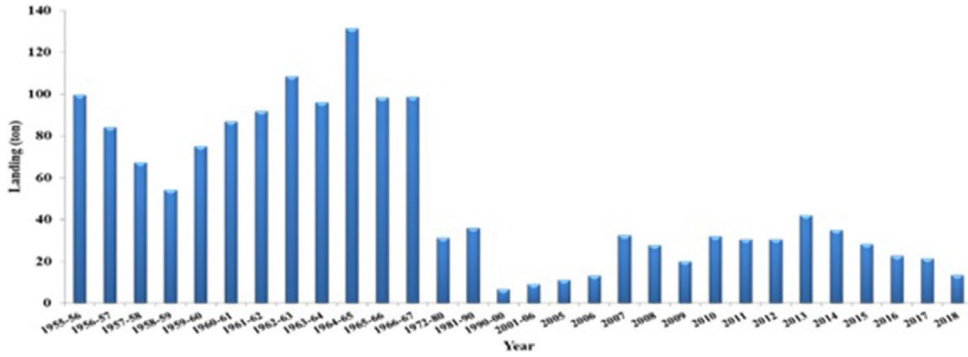

FIGURE 3 IMC landing at Allahabad during different periods

Average annual IMC landing during 2005–2018 was 25.61 tons only with 2013 having maximum landing (41.88 ton) and 2005 as least fish catch year (11.11 ton) for this period. Average contribution of IMC to total landing was 38.09% during 1956–1967 which reduced to 15.00% during 2005–2018. During 1956–1967, maximum contribution of IMC to total landing was 52.96% in 1966–1967 and least 17.30% in 1956–1957. On the other hand, maximum contribution of IMC to total landing was 24.67% in 2013 and minimum 8.49% in 2018 during time interval of 2005–2018.

Balbir, Singh, Tyagi, and Khan (1987) have reported that at Allahabad Mrigal used to dominate over the other IMC species until 1972 contributing over 50% had been reduced to below 20 per cent in 1990s and in past years (see Figure 4). Mrigal population was replaced by Calbasu which during 1990s contributed over 60% of the total IMC catch against earlier contribution of about 13.5 per cent. Calbasu landing which was recorded 16.0 ton only in 1973 has gone up to 35.0 ton in 1983. Species-wise landing of IMC at Allahabad has been depicted in Figures 5 and 6. Species-wise landing shows that Mrigal (*Cirrhinus mrigala*) was dominating species followed by Rohu (*Labeo rohita*), Catla (*Catla catla*), and Calbasu (*Labeo calbasu*) among IMC during 1956–1967, while Mrigal was followed by Catla, Rohu, and Calbasu during 2005–2018. There was drastic reduction in the catch of these species during 2005–2018. According to Jhingran and Ghosh (1978), the average share of IMC in total catch was 38.5% and share of Mrigal alone was more than 50% during 1958–1969. While there was only 3.3 ton catch of Mrigal in 2005 and that of Calbasu reduced to 1.33 ton in 2009 (Jha, Joshi, & Tyagi, 2017). Although catch of Mrigal had reduced but the catch of Catla had increasing trend during 2005–2018. The reason for this may be invasion of exotic fishes viz. *Cyprinus carpio* (common carp)

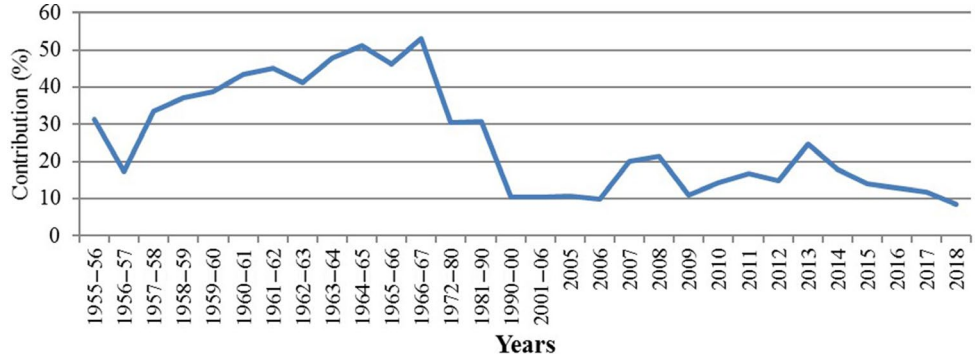

FIGURE 4 Contribution of IMC in total landing at Allahabad

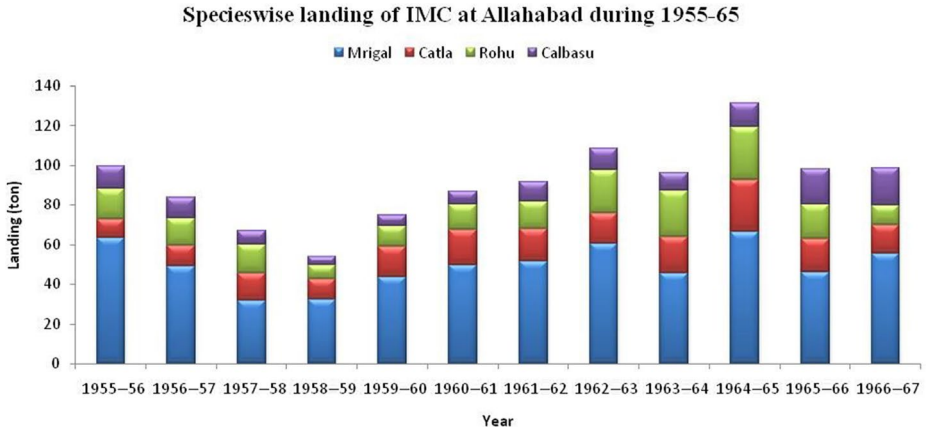

FIGURE 5 Species-wise landing of IMC at Allahabad during 1955–1965

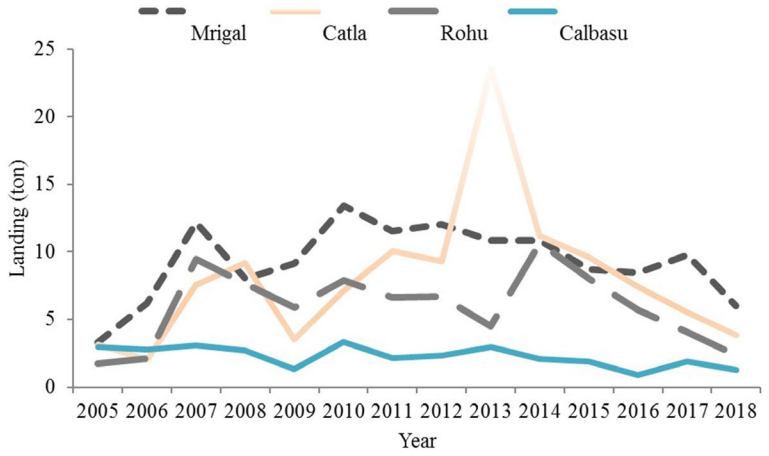

FIGURE 6 Species-wise landing of IMC at Allahabad during 2005–2018

and Oreochromis niloticus (tilapia*)* in the Ganga River system which resulted in competition for food between exotic and IMC (Figure 7).

Since multifarious stressors are operating on the River Ganga, tremendous alterations have been registered in its discharge, velocity, substratum, and quality of the abiotic and biotic parameters. Accordingly, fishery of the river in general and that of the sensitive species in particular is facing serious threats from loss of habitats, barriers on migratory paths, loss of deep pools, and drying of feeding and breeding grounds (Joshi, Jha, Alam, Das, et al., 2014). Due to these aberrations, the fish catch from the River Ganga has been declined and loss of species diversity has been reported by many workers (Joshi, Jha, Alam, Das, et al., 2014; Sinha & Khan, 2001). Research has also revealed loss of fish diversity, fisheries, and invasion of exotic species owing to decreased flow (Joshi et al., 2017). In case of damming a pristine river stretch, the environmental flow should be maintained optimally to sustain the downstream ecosystems and the rights of other stakeholders (Joshi, Jha, Alam, Srivastava, et al., 2014). As a result of environmental perturbations, the fisheries have suffered considerable and the present trends of species of IMC are quite different from those recorded earlier (Jhingran & Ghosh, 1978; Joshi, 2017; Singh, Payne, Pandey, & Singh, 1998). There was drastic decrease in the volume of Yamuna water at Allahabad due to the formation of Gandhi Sagar dam during 1970s on

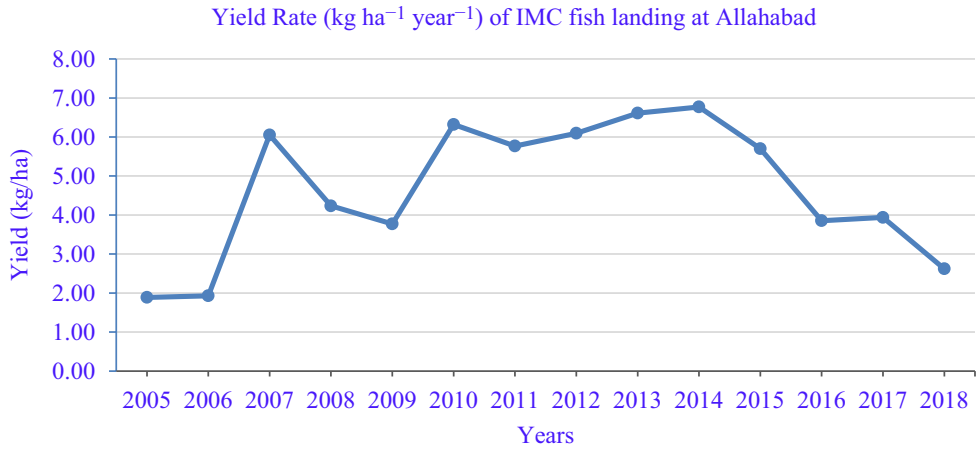

FIGURE 7 Yield rate (kg/ha) of Indian major carp at Allahabad during different periods

Chambal River, an important tributary of the River Yamuna. These dams had greatly reduced river flow, and erratic water releases, in the past, hence resulted in changing of river ecology (Hussain & Badola, 2001). Commissioning of Farraka barrage had led to decline the fishery at Allahabad in 1972–1980.

Jhingran and Gupta (1987) have claimed that in the middle and lower stretches of the Ganga, the average total yield has declined from 503 kg ha^{-1} year^{-1} from pre-1961 to 22.0 kg ha year^{-1} in the post-1972. The average yield rate of IMC dropped from 133 kg/ha to only 4.6 kg ha^{-1} year^{-1} with lower yields of C. *mrigala, C. Catla*, and *L. rohita* and an upward trend in the yield of *L calbasus* was recorded during 1990s. Average total yield of IMC during 1958–1969 has been shown in Table 2 at different centres. At Allahabad, it was ranging from 11.7 to 28.5 kg/ha during these periods. But during 2005–2018, it was ranging from 1.9 to 6.77 kg/ha. This shows the declined condition of IMC in the River Ganga.

TABLE 2 Trend of IMC catch (kg/ha) at various centers of the Ganga during 1958–1967

	Kanpur	Allahabad	Varanasi	Buxar	Ballia	Patna	Bhagalpur
1958–1959	85	11.7	2.9	30.4	13.4	12.7	3.5
1959–1960	91.3	16.3	3.6	16.7	12	11.5	3.7
1960–19 61	74.2	18.9	1.2	4	5.9	16	3.5
1961–1962	20.5	19.9	1.2	NA	7.4	17.9	4.1
1962–1963	39.8	23.5	0.9	NA	3.3	20.6	6
1963–1964	33.7	20.8	0.9	3.1	7	11.9	4.2
1964–1965	33.8	28.5	1.2	2.9	NA	12.6	6.9
1965–1966	21.5	21.4	3.4	6.7	NA	13.5	10
1966–1967	32	21.4	2.5	4.7	7	11.2	7.6
1967–1968	13.3	16.8	1.2	1.3	6	8.5	11
1968–1969	16.3	19.1	1.2	3.3	6.4	9.2	9.8

Source: Ray, 1998

4 | SPAWN PRODUCTION

The Ganga River system was the main source of IMC seed for culture in ponds and tanks. The Ganga and its tributaries yield enormous quantities of fish seed. The fish seed committee has estimated that in 1964 the Ganga River system contributed 89.5% of the total fish seed produced in the country. Estimated production of spawn in different states in 1966 is given in Table 3, while Figure 8 is showing the spawn collection from Ganga River and its tributaries along with total spawn (on secondary axis).

TABLE 3 Estimated collection of spawn from Ganga River in different states during 1966

Sl. No.	State	Spawn collection (Million)
1	U.P.	2,010
2	Bihar	1,200
3	West Bengal	122.2

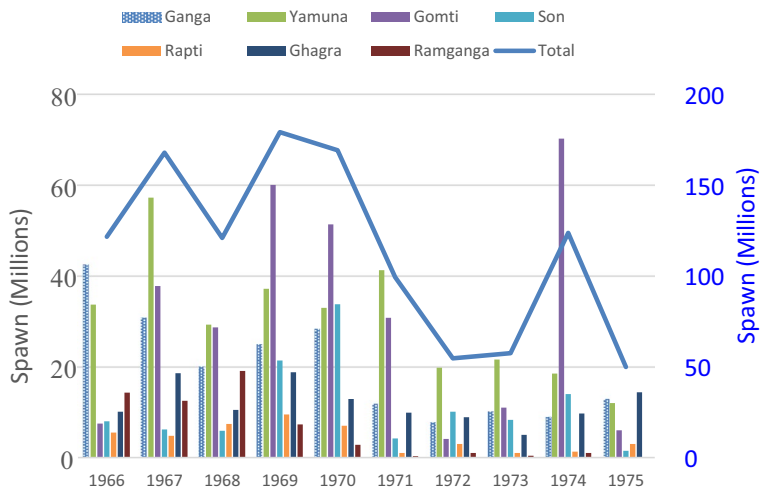

FIGURE 8 Spawn production in Ganga and its tributaries

Recent statistics showed that the spawn yield from the rivers has declined and no commercial spawn collection has been reported.

5 | CONCLUSION

Collection and analysis of fish catch data shows that there is drastic reduction in landing of Indian major carps from Ganga River system. Catch as well as species composition of fish and fishery had changed over the period of time (2000–2018) due to changes in hydrological regime and ecology of the river. At Allahabad, the average contribution of IMC to total landing was 38.09% during 1956–1967, which reduced to 15.00% during 2005–2018. The average total yield has declined from 503 kg ha^{-1} $year^{-1}$ from pre-1961 to 22.0 kg ha $year^{-1}$ in the post-1972. Average total yield of IMC during 1958–1969 was ranging from 11.7 to 28.5 kg/ha but has reduced to 1.9 to 6.77 during

2005–2018. Since the Ganga River system is known as an original abode of IMC, there is a need to propagate and conserve these species in the river system. A sizeable population of IMC in the river would also help the thousands of fishers residing along the riverbank in augmentation of their livelihood security, as these species fetch lucrative price and highly demand in the market by the fish eaters.

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